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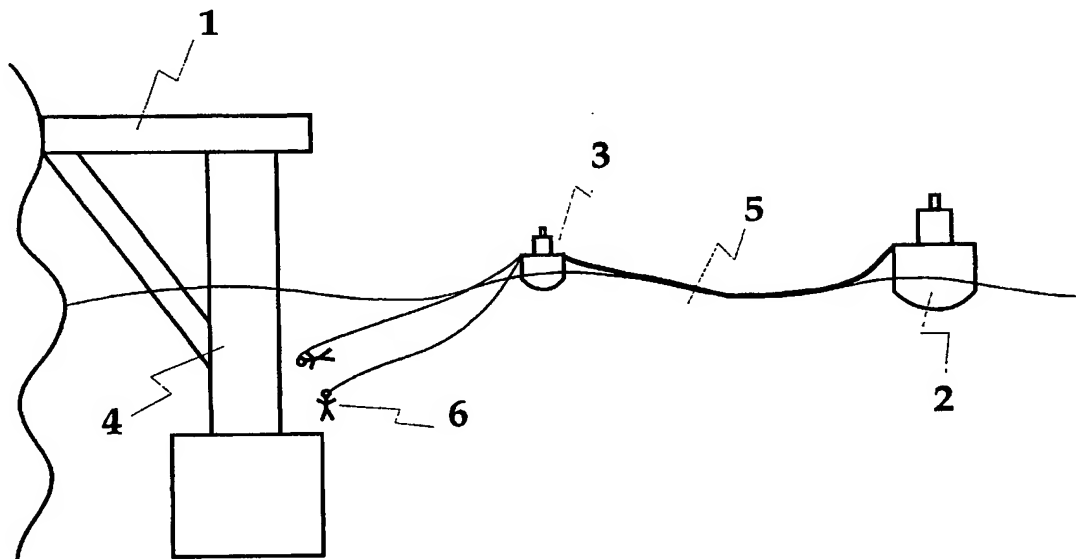
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(72) Inventor: KASTER, Fernando Guilherme Castanheira [BR/BR]; Estrada do Piaf, N° 4027 - Sepetiba, 23530-610 Rio de Janeiro (BR). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SATELLITE SYSTEM FOR SHALLOW DIVING



(57) Abstract: The present invention refers to a shallow diving system in open sea that consists of a main vessel (2) provided with dynamic positioning system (DP) and with the equipments to monitor diving operations, and give assistance and orientation to the divers (6). The main vessel (2) operates with support vessels (3), and together they set the divers (6) and support team at the work location (4), at a safe distance from the main vessel propulsion system, to perform the job on the offshore units(1). These vessels for supporting diving operation, act like satellites of the main vessel, linked to it by means of a umbilical line (5).

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SATELLITE SYSTEM FOR SHALLOW DIVING

Field of the Invention

The present invention deals with a shallow diving system (up to 50 meters), carried out in open sea for the main objective
5 of inspecting, sub aquatic surveying and repairing services in offshore installations, as for example platforms, vessels and equipments that work continuously at the sea.

To reach such an objective, the diving system operates externally the offshore installation where the service is required,
10 in a main vessel provided with dynamic positioning system, and where are arranged the support equipment necessary to the diving operation.

The main vessel is suitably positioned nearby the location where the diving will be executed, using a secondary vessel for
15 direct support and assistance.

This secondary vessel functions like a satellite of the main vessel.

Background of the Invention

Nowadays, the shallow diving systems used in oil
20 exploitation and production offshore platforms that operate in deep waters are based and operated from the same unit where the inspecting work will be performed.

In offshore platforms the physical space is limited. After installing exploitation systems, their facilities, safety systems,
25 accommodations, loading areas, winches, cranes, heliport and

escape routes, there are few remaining spaces on board.

Diving systems in use are arranged in these remaining spaces, and they utilize as a transportation mean to access the submerge region, an open bottom diving bell or basket, that is kept suspended and vertically lowered by means of an articulated structure that extends outside the platform structure. These systems, however, can only control the open bottom diving bell positioning in the vertical direction, the necessary horizontal displacement is obtained by moving the divers away from it, at the depth work, by using an umbilical line that links them. Due to the few available space for installing the diving equipments, the distances between diving places and work places demand the use of long umbilical lines, that require a greater physical effort from the divers, and increase considerably the risk of the operation that may become unsafe or not be feasible in different points of the unit.

Many occurrences have demonstrated that the arrangements made for launching and rescuing the divers, as those used for shallow diving systems, located in platforms, could not guarantee the immediate rescue of injured / endangered divers.

Generally the only way for doing the rescue, is with the open bottom diving bell itself or the diving basket, that most of the time can not be placed where the diver is, or can not be immediately raised due to untangled umbilical lines and/or

other reasons.

Floating production, storage and off-loading units, known as FPSO, that are authorized to operate for periods up to twenty years, without dry-docking, have their structural integrity
5 verified by programmed sub aquatic surveys, together with non destructive test (NDT) inspection, in all the hull extension, and the execution of the repairs identified as necessary.

The activities comprised in the job for sub aquatic inspection and repairing demand a peculiar structure entirely
10 dedicated, with facilities to give support to the divers' life and adequate working conditions, safety and effectiveness for the job.

The optimization of space on the production units clearly indicates that an improvement in the actual operating conditions
15 for diving systems will be reached only with an evolution within the concept that overtakes the present critical points, listed bellow:

- difficulty in rescuing the divers in an emergency situation;
- short range for the horizontal reaching capability, limited
20 by the umbilical line length that can be handled securely;
- great difficulty to access different points of the platforms;
- divers physical effort due to the use of long umbilical line;
- necessity to move (re install) the support equipments;
- there is the need of two men in the water: one man
25 working, and the other to handle the umbilical line, from

the open bottom diving bell or basket;

- any emergency assistance or rescue activity become more difficult to provide since the other persons remain on the platform deck, 15 meters above;
- 5 - delivering material and tools to the divers, at their work location;
- job poor performance figures;
- no space on the platforms for the installation of support equipments;
- 10 - no accommodations for extra crew;

Summary of the Invention

The present invention is a new concept of shallow diving system (up to 50 meters), in open sea, that is a safer and a more efficient alternative to carry out this job, which makes possible
15 for the divers to move around in order to get access and operate in safe conditions in all points of the hull. The diving system, including all the support equipment, operates from another vessel, provided with dynamic positioning system, located nearby the job place, on board of which are arranged the
20 auxiliary equipment necessary to support the diving operation.

The system now proposed consists of a main vessel, provided with a dynamic positioning system (DP) and with the equipments to monitor the diving operation, to give assistance and orientation to the divers. The main vessel operates with
25 support vessels, and together they set the divers and the support

team at the work location, at a safe distance from the main vessel propulsion system.

These vessels for direct supporting the diving operation, act like satellites of the main vessel, linked to it by means of umbilical lines.

Brief Description of drawings

Figure 1 shows a schematic plan view of the diving system object of the present invention.

Figure 2 represents a schematic profile view of the system presented in Figure 1.

Detailed Description of the Invention

The invention will be better understood if described together with the Figures, which are part of this report.

The shallow diving system in open sea utilizes a vessel, named main vessel 2, which is positioned nearby the installation unit 1, and is used as a base for working, that operates together with an auxiliary support vessel 3, smaller, referred as diving boat, from now on.

The main vessel 2 is provided with a dynamic positioning system, an uninterrupted power generation system for the diving system, capable of assure the divers' decompression in emergency situation but, in accordance with the procedures adopted during normal conditions, and being able to comply with the legal regulations established for shallow diving operations.

The diving boat, vessel 3, must provide the operational and safety utilities. It must have redundancy in the propulsion power system by dual water jet units in order to guarantee the motion, positioning and protection of the people in the water, and also
5 have a control panel for three divers, two actually diving and one diver in safety "stand by", an operation control panel to make possible a complete control and follow-up, through audio, video and registered data, of the supplied pressures and depths, and a video camera for each diver in the water and one camera
10 placed under the hull. That means audio and video communication, to guide and register the operations, from the main diving control center, located near the dynamic positioning system control in the main vessel, up to the divers working in the water, with control of the diving supervisor in the diving
15 boat.

Further, the diving boat must have an emergency air compression system, which consists of two high pressure bottles with enough capacity to decompress two divers (about 60 liters / 3000 psi), considering the maximum time foreseen in a 50 meters
20 diving.

The diving boat shall have an arrangement to handle the diving umbilical lines, space for a stretcher with a person laying down, equipment for first aid and be able to transport eight people, as a minimum, i.e., a diving supervisor, two support
25 divers, one diver as in stand by, two official divers, one boat

operator and one auxiliary man.

Description of the Preferred Embodiment

According to previous description, the main vessel 2 must have the accommodations for the crew and the diving system team, space to assemble the auxiliary equipment, and be a fixed
5 referenced platform for the whole system positioning. When it is positioned nearby the unit in the sea, installation 1, it shall make possible the correct positioning of the diving boat, vessel 3, on the desired work location, indicated as 4. The diving boat 3,
10 connected to the main vessel 2 by means of supply umbilical, indicated as 5, render possible the assistance and support to the diving operation, from a point at the surface straight above the desired work location, and also provide a minimum distance between the divers, indicated as 6, and the main vessel propeller
15 system for a safe operation (about 30 meters).

The umbilical line has positive buoyancy and is used as an auxiliary device for the positioning of the diving boat in relation to the main vessel.

During the diving operation the umbilical line is kept at the
20 proper length and tension in the desired direction by the diving boat pulling on the line, the load is applied and controlled by the diving boat and this keeps the desired diving position stable.

Among other advantages the following ones are emphasized:

25 - the divers and the team for supporting the diving

activity work as near as possible to the desired work location;

- guarantee immediate rescue of the divers in emergency conditions;
- 5 - improve the assistance to the divers in normal conditions by facilitating the delivering of tools and material to do the job;
- make feasible the work of two divers concomitantly, with a third one as a safety stand-by diver, inside the
- 10 diving boat;
- provide an unlimited supply, from the main vessel, of the utilities required for normal diving operation conditions, through the umbilical line that connects the diving boat to the main vessel, that also limits the
- 15 maximum distance between the boats;
- guarantee the diving boat autonomy in relation to the diving systems provisions, and position keeping capabilities to stay at the desired position after disconnecting the umbilical line that links it to the main
- 20 vessel, in order to realize the rescue of the divers safely in emergency conditions;
- redundancy in the launching and rescue systems of the diving boat, provided that the operation may be executed with the boat at its full capacity, with the crew
- 25 inside it.

An extraordinary improvement in job performance comes forth when using this new concept for shallow diving system, and is clearly noticed by those with a skill in the art.

CLAIMS

1. Satellite system for shallow diving in open sea
characterized by comprehending a main vessel (2)
provided with a dynamic positioning system, and with the
5 equipments to monitor the diving operation, to give
assistance and orientation to the divers; the main vessel (2)
operates with support vessels (3), connected by means of
an umbilical line (5) and together they set the divers (6)
and the support team at the work location (4), at a safe
10 distance from the main vessel (2) propulsion system.
2. Satellite system for shallow diving in open sea according to
claim 1, characterized by the main vessel (2) be provided
with all equipments to diving monitoring and to give
assistance and orientation to divers (6).
- 15 3. Satellite system for shallow diving in open sea according to
claim 1, characterized by the main vessel (2) be used as
base for diving work.
4. Satellite system for shallow diving in open sea according to
claim 1, characterized by the diving boat (3) be connected
20 to the main vessel (2) by supplying umbilical (5).
5. Satellite system for shallow diving in open sea according to
claims 1 and 4, characterized by said diving boat (3)
supporting diving operation from a point at the surface,
above the desired work position (4).
- 25 6. Satellite system for shallow diving in open sea according to

claim 1, characterized by the umbilical line (5) to be positive buoyancy.

7. Satellite system for shallow diving in open sea according to claim 1, characterized by the umbilical line (5) be used for positioning the support vessel (3) relative to the main vessel (2).

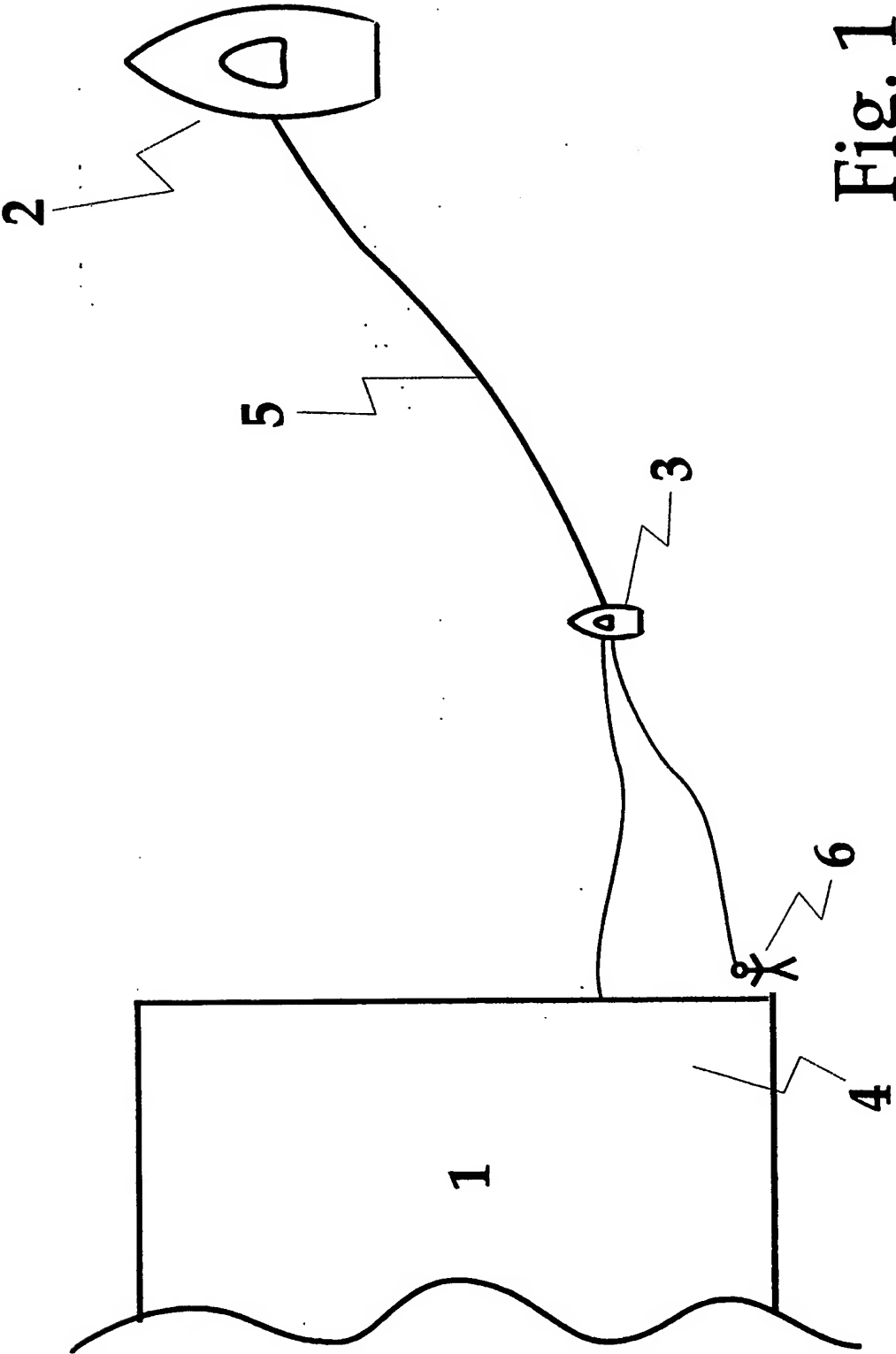


Fig. 1

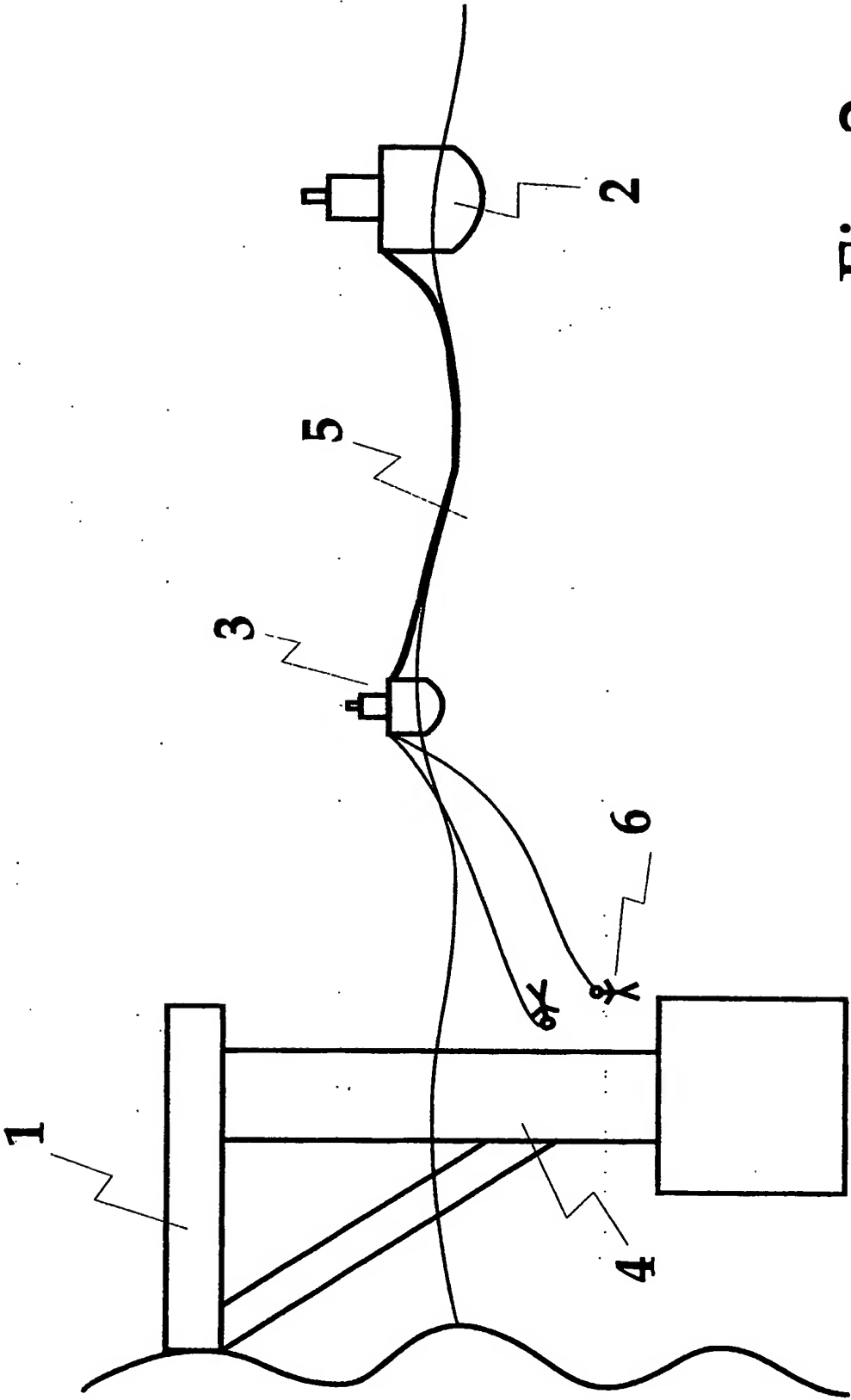


Fig. 2

INTERNATIONAL SEARCH REPORT

International Patent Classification No.

PCT/BR 03/00155

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B63C11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B63C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01 89921 A (FAGERHOM JOHAN ;HARRIE PER (SE); KURDVE MICHAEL (SE); LINDSJOE JOH) 29 November 2001 (2001-11-29) page 6, line 15 - line 31; figure 1 ----	1
A	US 4 208 152 A (COLSTON JOHN R) 17 June 1980 (1980-06-17) column 2, line 42 - line 57; figure 1 -----	1

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Further documents are listed in the continuation of box C.

☒

Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *8* document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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